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Effects of consuming cooked, fresh and fried groundnut (*Arachis hypogaea*) on hematological parameters and renal markers in male Wistar rats

[1*]Edibamode Ezon-Ebidor Innocent, [2]Iboro Efiong Edet, [3]Harrison Eruoto, [4]Onoja Patience

[1]Department of Anatomy, Faculty of Basic Sciences, College of Health Sciences, University of Port Harcourt;

[2]Department of Anatomy, Faculty of Basic Sciences, College of Health Sciences, University of Uyo, Uyo;

[3]Department of Medical Biochemistry, Faculty of Basic Sciences, College of Health Sciences, University of Port Harcourt;

[4]Department of Anatomy, Faculty of Basic Sciences, Madonna University, Elele, Nigeria.

Corresponding author: Edibamode Ezon-Ebidor Innocent

E-mail: innocent.edibamode@uniport.edu.ng Tel: +2348056105980

Abstract

Groundnut (*Arachis hypogaea*) is an annual legume crop grown mainly for its edible seeds. It is very nutritive and considered to be healthy for human diet because of its health benefits. However, individuals have been observed to react to its different processed forms. This study, as a two phase study, was conducted with the aim of investigating the effect of cooked, fresh and fried *arachis hypogaea* consumption on hematological parameters and renal biomarkers in male Wistar rats. Forty male Wistar rats randomly distributed into 4 groups of 10 animals each in the control and experimental groups (Group A, B and C) were used for this study. Control group was fed with standard basal diet and water *ad libitum* throughout the research period, while Groups A, B and C were fed with 50% cooked, fresh and fried groundnut with 50% basal diet mixture and water *ad libitum* respectively for 30 days (Phase 1) after which they were all later fed with standard basal diet for another 30 days (phase 2). Blood samples were analyzed for hematological and renal biomarkers. This study revealed therefore the mixture of fifty percent groundnut and fifty percent standard feed consumption to influence some hematological parameters and urea and creatinine renal markers with a non-significant weight reduction in the groundnut treated groups. This study has also revealed the different forms of groundnut to vary significantly in phytochemistry and proximate analysis.

Keywords: Groundnut, Consumption, hematological parameters, renal biomarkers, Wistar rats

INTRODUCTION

Groundnut is one of the most widely consumed legumes and has being reported by a few to cause respiratory reaction following its consumption. It is a species in the legume family, *Fabaceae* and it is one of the major oil seed crops of the world being the world's fourth most important source of edible vegetable oil and the third most important source of vegetable protein feed meal[1]. The methods of processing food have been known to influence and alter the nutrients in fruits and vegetables [2]. Groundnut can be consumed as raw, roasted or mixed with other foods or in different processed forms. It comprises of skin, hull and kernel (seed). Its hulls exhibit appreciable antioxidant activity and antimutagenic effect [3], while its kernels have been found to be rich in antioxidants as that of blackberries and strawberries. Its major components are protein and fatty acids like palmitic acid, oleic acid and linoleic acid [4]. It is also a rich source of magnesium (Mg), foliate, fiber, alpha tocopherol, copper, arginine, oxalate, phenolic compound [5]. It has lipid lowering effects, decreases the body weight as well as being a significant source of resveratrol, a chemical studied for potential anti-aging, anti-cancer and anti-inflammatory influences [6]. About a decade ago, some researchers observed it to significantly reduce glycerol induced elevation of serum urea and creatinine levels in rats which indicate protective effect of this crop against renal injury [7]. Its antioxidant properties have been documented to keep liver marker enzymes normal [8]. On the contrary, some other investigators found kidney stones in hypertensive patients due to its consumption with beer suggestive of kidney injury [9].

The kidney is a vital organ in the body and its function is essential for healthy living [10, 11]. Kidney disease is a worldwide public health problem due to an increase in both incidence and prevalence in the last decade. Dysfunction of kidney indicates severe disorders, which leads to various physiological and pathological complications [11.] With regards to lifestyle factors, diet appears to have an important role in the prevention and development of these diseases and some nutritional factors or dietary patterns are responsible for the progression of kidney disease [12]. From ancient time, various plants as well as herbal preparations are used for enhancement of kidney function [2.] However, no specific dietary pattern has been recognized by high-level evidence based studies for prevention of these diseases [13].

Kidney diseases are potentially serious and cause high morbidity and mortality in many countries. In recent years, great effort has been focused on natural food and diet for providing protection against kidney and liver damage. Groundnut consumption has been declared safe but it may produce allergic and anaphylactic reactions [14]. All food proteins have a potential to be allergic to some people. Nuts and legumes are some of the main food allergens consumed by a large number of people [15]. According to the study [15], allergy to groundnut and tree nuts is the most common food allergy and it has been documented to affect about 1 in 50 young children. This study therefore investigated the effect of the consumption of three processed forms of 50% groundnut mixed with 50% standard rat feed with the objectives of analyzing and comparing the mean weight of animals, renal biomarkers and hematological parameters

MATERIALS AND METHODS

Ethical clearance

Ethical clearance was obtained from the University of Port Harcourt Research Ethics Committee. The Research Ethics Committee protocols were strictly adhered to and the internationally accepted principles for laboratory animal use and care were also adopted

Procurement and identification of groundnut

Five (5) kg of groundnut procured from mile 1 market Port Harcourt, Rivers State were used for this study. The groundnut was thereafter identified and authenticated by a plant scientist in Ecoland Herbarium (EB) as *Arachis hypogeae* with the voucher number of EH/P/076.

Animal procurement and acclimatization

Forty male Wistar rats weighing between 150 to 170 g were purchased from the animal house of the College of Health Sciences, University of Port Harcourt Nigeria were used for this study. The animals were housed in standard cages under the same laboratory conditions of photo-period (12 h light/12 h dark) and acclimatized for 14 days.

Animal grouping and feeding

The animals were randomized into four (4) groups with each group consisting of 10 rats.

Control group **-** fed with standard feed (100 g) and water *ad libitum* throughout the study for the first and second phases of the study.

Groups A, B and C were fed with a mixture of 50 g standard feed and 50 g cooked groundnut; 50 g standard feed and 50 g fresh groundnut and 50 g standard feed and 50 g fried groundnut respectively in the ratio of 1:1 totaling 100 g of feed and water *ad libitum* for the first 30 days only (phase 1), while for the second 30 days, which is a recuperation phase (Phase 2), the animals were fed with standard rat feed only.

Preparation of groundnut

The procured groundnuts were subjected to the different preparatory processes to achieve the different desired forms:

Cooked groundnut: Some of the fresh groundnut bought were cooked every two day interval for about 20 minutes, drained the water, grounded and transferred to a can for proper storage.

Fresh groundnut: Some of the fresh groundnuts bought were kept aside without further processing and transferred to a can for proper storage

Fried groundnut: Some of the fresh groundnut bought were fried and transferred to a can for proper storage.

Serum Biochemical/Hematological Analysis

At the end of phase one and two, blood samples were collected via the internal jugular vein using a 5ml syringe into Ethylenediamine tetraacetic acid (EDTA) bottle for hematology and serum biochemistry analyses. The haematological parameters were analyzed using a 5-part automated hematology analyzer while the renal markers were analyzed by a spectrophotometer using random kit. Hematological parameters analyzed were: White Blood cell count (WBC), Red Blood Cell count (RBC), Haemoglobin concentration (Hb), Platelet count (PLT). Granulocyte count (neutrophils and eosinophils), lymphocytes and monocytes. Serum biochemistry were performed to analyze creatinine and urea levels as major renal bio-markers.

Data Analysis

The data obtained for the study was subjected to statistical analysis using the International Business Machine of Statistical Package for Social Sciences (IBM SPSS version 23) and the results were expressed as mean ± standard error of mean presented in tables. One-way analysis of variance and post hoc test was used as inferential statistics for the study and a probability less than 0.05 was considered statistically significant ($p<0.05$). Confidence interval was denoted as 95%.

RESULTS

This study looked at the effects of the consumption of three different forms of groundnut on hematological parameters, renal markers as well phytochemistry of the three forms of groundnut in two phases.

Table 1 showed the proximate analysis of the nutrients of cooked, fresh and fried groundnuts using one-way analysis of variance. Significant differences were observed in the percentage of moisture content, crude protein ash, carbohydrate and energy.

Table 1: Analysis of variance of Proximate Analysis of the Nutrients of Cooked, Fresh and Fried groundnut

Parameters	Cooked (Mean ±SEM)	Fresh (Mean ±SEM)	Fried (Mean ±SEM)	p-value
MC (%)	10.56±0.02	4.65±0.02	3.04±0.03	0.0001*
CP (%)	18.38 ± 0.01	20.82 ± 0.01	10.94 ± 0.01	0.0001*
CF (%)	2.75 ± 0.01	4.38 ± 0.01	3.10 ± 0.51	0.061
FAT (%)	41.82 ± 0.01	50.45 ± 0.01	38.75 ± 5.50	0.158
ASH (%)	3.60 ± 0.05	3.06 ± 0.00	1.94 ± 0.00	0.0001*
CHO (%)	26.33 ± 0.01	20.67 ± 0.05	28.64 ± 0.01	0.0001*
EV (%)	565.06 ± 0.12	610.31 ± 31.50	556.61 ± 0.12	0.0001*

*Significance is at p< 0.05. Mc- moisture content, CP- crude protein, CF- crude fiber, CHO- carbohydrate, EV- energy

Table 2 showed the proximate analysis of the anti-nutrients of cooked, fresh and fried groundnuts using one-way analysis of variance. Significant differences were observed across the groups in all tested parameters

Table 2: Analysis of variance on Proximate Analysis of the Anti-nutrients of Cooked, Fresh and Fried groundnut

Parameters	Cooked (Mean ±SEM)	Fresh (Mean ±SEM)	Fried (Mean ±SEM)	p-value
Alkaloid (mg/g)	0.43 ± 0.01	0.48 ± 0.01	0.36 ± 0.01	0.003*
Flavonoid (mg/g)	0.32 ± 0.01	0.38 ± 0.01	0.21 ± 0.01	0.005*
Saponin (mg/g)	0.65 ± 0.01	0.71 ± 0.01	0.52 ± 0.01	0.002*
Tannin (mg/g)	2.62 ± 0.01	2.84 ± 0.00	2.30 ± 0.00	0.0001*
Phytate (mg/g)	1.37 ± 0.01	1.31 ± 0.01	1.21 ± 0.00	0.002*
Oxalate (mg/g)	1.07 ± 0.01	1.17 ± 0.01	0.94 ± 0.01	0.0001*
Trypsin (TUI/g)	0.18 ± 0.00	0.21 ± 0.01	0.06 ± 0.00	0.001*

*Significance is at p< 0.05

Table 3 showed the proximate analysis of the mineral composition of cooked, fresh and fried groundnuts using one-way analysis of variance. Significant differences were observed across the groups in the tested parameters except iron

Table 3: Analysis of variance of Mineral Composition of Cooked, Fresh and Fried groundnut

Parameters	Cooked (Mean ±SEM)	Fresh (Mean ±SEM)	Fried (Mean ±SEM)	p-value
Ca(mg/g)	42. 05 ± 0.02	38.11 ± 0.01	31.85 ± 0.01	0.0001*
Na(mg/g)	68.21 ± 0.01	65.37 ± 0.01	60.16 ± 0.02	0.0001*
Mg(mg/g)	106.31 ± 0.02	101.26 ± 0.02	97.53 ± 0.01	0.0001*
P(mg/g)	371.81 ± 0.02	367.12 ± 0.01	360.65 ± 0.01	0.0001*
K(mg/g)	530.16 ± 0.02	527.27 ± 0.02	520.81 ± 0.01	0.0001*
Fe(mg/g)	2.05 ± 0.00	2.02 ± 0.01	2.02 ± 0.01	0.100
Zn(mg/g)	3.52 ± 0.02	3.65 ± 0.02	3.41 ± 0.01	0.002*

*Significance is at $p < 0.05$

Table 4 showed the proximate analysis of vitamins of cooked, fresh and fried groundnuts using one-way analysis of variance. Significant differences were observed across the groups in all tested parameters

Table 4: Analysis of variance for vitamin composition of cooked, fresh and fried groundnut

Parameters	Cooked (Mean ±SEM)	Fresh (Mean ±SEM)	Fried (Mean ±SEM)	p-value
A(g)	41.86 ± 0.01	20.51 ± 0.00	32.61 ± 0.01	0.0001*
B1(g)	0.64 ± 0.01	0.41 ± 0.01	0.11 ± 0.01	0.0001*
B2(g)	0.10 ± 0.00	0.07 ± 0.00	0.04 ± 0.00	0.004*
B3(g)	13.46 ± 0.01	9.87 ± 0.01	8.72 ± 0.01	0.0001*
C(g)	10.46 ± 0.01	7.14 ± 0.00	8.95 ± 0.00	0.0001*
E(g)	0.61 ± 0.10	0.56 ± 0.01	0.38 ± 0.01	0.001*

*Significance at the 0.05 levels

Table 5 revealed the analysis of weight of cooked, fresh and fried groundnut groups using one-way analysis of variance. No significant differences were observed across the groups in the mean weights.

Table 5: Analysis of variance on weight changes among the various groups

Parameters	Control (Mean ±SEM)g	Cooked (Mean ±SEM)g	fresh (Mean ±SEM)g	Fried (Mean ±SEM)g	p-value
Initial	92.00 ± 1.09	93.10 ± 4.86	91.30 ± 4.4	90.60 ± 3.27	0.975
Day 14	122.00 ± 4.38	111.30 ± 7.08	109.40 ± 6.38	111.70 ± 4.91	0.654
Day 44	136.80 ± 9.22	135.67 ± 11.61	140.40 ± 8.95	129.20 ± 5.17	0.820
Day 74	223.50 ± 10.50	168.33 ± 14.09	211.40 ± 14.94	186.20 ± 5.83	0.064

* denotes Significance at the 0.05 levels (when compared with the control group)

Table 6 showed the analysis of variance on hematological parameters of cooked, fresh and fried groundnut groups at the end of phase one. Significant differences were observed across the groups in red blood cell level only

Table 6: Analysis of Variance on Hematological Parameters at the end of Phase 1

Parameters	Control (Mean ±SEM)	Cooked (Mean ±SEM)	Fresh (Mean ±SEM)	Fried (Mean ±SEM)	F-value	p-value
PCV(%)	45.00 ± 5.00	42.00 ± 1.30	46.00 ± 0.63	45.20 ± 1.46	1.461	0.271
Hb(g/dl)	15.75 ± 0.95	13.96 ± 0.43[a, c]	15.32 ± 0.21[b]	15.06 ± 0.48	2.703	0.089
WBC (10^9µ)	3.7 ± 0.70	5.00 ± 1.32	4.98 ± 0.71	7.06 ± 0.91	1.459	0.271
Platelet (10^6 µ)	150.00 ± 5.00	200.0 ± 30.18	204.0 ± 15.59	176.0 ± 14.45	.890	0.472
RBC (10^{12}µl)	8.70 ± 0.10	5.56 ± 0.44[a]	5.98 ± 0.12[a]	6.34 ± 0.16[a]	13.359	0.0001*
Neut(%)	10.00 ± 1.00	20.80 ± 8.93	7.20 ± 2.75	12.20 ± 3.59	.398	0.398
Lymp (%)	88.00 ± 2.00	71.20 ± 9.85	85.80 ± 4.90	72.60 ± 4.71	1.330	0.307
Mono (%)	0.50 ± 0.50	5.00 ± 2.10	5.40 ± 2.73	8.80 ± 1.88	1.475	0.267
Eosin (%)	1.50 ± 0.50	2.00 ± 0.95	1.60 ± 0.68	2.40 ± 1.29	.145	0.931

*significance was set at p< 0.05. a-denotes significance when compared with control, b-denotes significance when compared with cooked, c-denotes significance when compared with fresh, d-denotes significance when compared with fried. PCV-packed cell volume, Hb-hemoglobin, WBC- white blood cells, RBC- red blood cells, Neut- Neutrophil, Lymp- lymphocyte, Mono- monocyte, Eosin- eosinophil

Table 7 showed the analysis of variance on hematological parameters of the cooked, fresh and fried groundnut groups at the end of phase two. Significant differences were observed across the groups in red blood cell, hemoglobin, packed cell volume and white blood cell levels only.

Table 7: Analysis of variance on Hematological Parameters at the end of Phase 2

Parameters	Control (Mean ±SEM)	Cooked (Mean ±SEM)	Fresh (Mean ±SEM)	Fried (Mean ±SEM)	F- value	p-value
PCV (%)	38.50 ± 0.50	36.80 ± 2.22[c]	51.00 ± 1.87[a, b]	44.50 ± 2.22[b]	9.802	0.002*
Hb (g/dL)	13.00 ± 0.00	12.26 ± 0.73[c]	17.00 ± 0.61[a, b]	14.75 ± 0.74[b, c]	9.839	0.001*
WBC (10^9µ)	14.50 ± 0.30	3.54 ± 0.85[a]	5.12 ± 1.69[a]	3.00 ± 0.69[a]	10.592	0.001*
Platel (10^9µ)	112.50 ± 3.50	174.80 ± 27.14	172.80 ± 24.89	209.50 ± 37.29	1.150	0.369
RBC (10^{12} µ)	4.7 ± 0.10	4.58 ± 0.54	7.50 ± 0.61[a, b]	6.22 ± 0.83	4.647	0.022*
Neut (%)	22.50 ± 1.50	25.40 ± 3.82	13.80 ± 4.59	22.00 ± 3.54	1.665	0.227
Lymph (%)	70.50 ± 0.50	68.00 ± 3.86	78.00 ± 5.94	71.00 ± 3.94	.900	0.469
Mono (%)	2.50 ± 0.50	4.60 ± 0.24	5.60 ± 1.57	5.25 ± 0.48	1.103	0.386
Eosin (%)	4.50 ± 0.50	2.40 ± 0.81	2.60 ± 0.87	1.25 ± 0.63[a]	1.698	0.220

*Significance was set at 0.05 level. a-denotes significance when compared with control, b-denotes significance when compared with cooked, c-denotes significance when compared with fresh, d-denotes significance when compared with fried. PCV-packed cell volume, Hb-hemoglobin, WBC- white blood cells, RBC- red blood cells, Neut- Neutrophil, Lymp- lymphocyte, Mono- monocyte, Eosin- eosinophil

Table 8 explored analysis of variance on renal markers of the cooked, fresh and fried groundnut groups at the end of phase one. Significant differences were observed in the urea level between the control and cooked groundnut groups; in creatinine level between the control and cooked groundnut groups only.

Table 8: Analysis of variance on Renal Biomarkers at the end of Phase 1

Parameters	Control (Mean ±SEM)	Cooked (Mean ±SEM)	Fresh (Mean ±SEM)	Fried (Mean ±SEM)	F-value	p-value
Urea mol/L	1.50 ± 0.28	2.46 ± 0.92[a]	3.38 ± 0.91	2.40 ± 0.84	2.589	0.098
Creatinine µmol/L	70.50 ± 2.12	140.40 ± 10.55	96.40 ± 41.50	124.20 ± 40.93	2.881	0.076

***Significance** was set at 0.05 level. a-denotes significance when compared with control, b-denotes significance when compared with cooked, c-denotes significance when compared with fresh, d-denotes significance when compared with fried.

Table 9 explored analysis of variance on renal markers of the cooked, fresh and fried groundnut groups at the end of phase two. Significant differences were observed in the urea level between the fried and fresh groundnut groups; in creatinine level between the fried and cooked groundnut groups only.

Table 9: Analysis of variance on Renal Biomarkers at the end of Phase 2

Parameters	Control (Mean ±SEM)	Cooked (Mean ±SEM)	Fresh (Mean ±SEM)	Fried (Mean ±SEM)	F-value	p-value
Urea (mmol/L)	1.10 ± 0.14	2.16 ± 0.44	1.96 ± 0.80	3.10 ± 0.84[c]	4.328	0.028*
Creatinine (µmol/L)	122.50 ± 3.54	123.20 ± 7.89	91.60 ± 35.15	75.00 ± 32.39[b]	3.129	0.066

***Significance** was set at 0.05 level. a-denotes significance when compared with control, b-denotes significance when compared with cooked, c-denotes significance when compared with fresh, d-denotes significance when compared with fried.

DISCUSSION

Phytochemistry /Proximate Analysis

On analysis of the major nutrients in the cooked, fresh and fried groundnuts; crude protein, carbohydrate, energy, ash and moisture content showed statistical significant difference with cooked groundnut displaying the highest mean in moisture and ash percentage content. The fried groundnut has the lowest moisture content which in turn contributes to the fried groundnut's high shelf life and storage capacity than the cooked and fresh samples [16]. Due to high moisture content of the cooked groundnut, they can easily get spoiled because water provides enabling environment for microbial growth. Similarly, the fried groundnut has the lowest ash content when compared with the cooked and fresh sample, and this result is in agreement with the work of Musa *et al.* [17] who worked on the proximate composition of selected groundnut varieties. This implies that during processing, some of these inorganic components may have leached out of the seed during frying/roasting, thus losing some of the inorganic components.

Carbohydrate percentage was highest in the fried groundnut while fresh groundnut had the highest energy percentage. The carbohydrate percentage for the three forms of groundnut are significantly different with the fried and cooked groundnut having the highest carbohydrate content which implies that the bioavailability of carbohydrate molecules of the samples increases during processing, and this is in agreement with the work by Nwaogu and Udebuani [18] who investigated the effect of processing on the nutritional and toxicological components of Cleome rutidosperma seed. Meanwhile, the percentage crude fiber and fat were insignificant in the cooked, fresh and fried groundnuts.

The fried groundnut has the lowest protein content when compared to the cooked and fresh which could also be as a result of the processing since applied heat causes denaturation of the protein thus making the fresh groundnut is a richer source of protein [19 20]. As for the energy value (E), the fresh groundnut has the highest energy value and this is in conformity with the work by Mada *et al*., [19]. Most of the results obtained from this study suggest that the fresh groundnut consist of nutrients and these nutrients are denatured when they are processed especially during frying.

As for the anti-nutrients analyzed, all tested parameters were statistically significant with the fresh groundnut displaying the highest percentage except in phytate which was highest in cooked groundnut. All analyzed minerals (calcium, sodium, magnesium, potassium, phosphorus, zinc and iron) displayed significant difference in the three forms of groundnut except iron. The cooked groundnut displayed the highest in these minerals except zinc that was highest in the fresh groundnut.

Similarly, the cooked groundnut displayed the highest mean value in the vitamin content analyzed (vitamins A, B1, B2, B3 C and E). These vitamins were observed to be statistically significant across the group. This variation in the nutrients and anti-nutrients may be attributed to the different methods of food processing which have been known to influence and alter the nutrients in fruits and vegetables [2].

Weight Changes

Analysis on the mean body weight gain across the four groups showed no statistical significant difference. However, the highest mean weight gain was recorded in the control group while the least was in the cooked groundnut group. Though not significant, our study tends to conform with the work done by Sadia *et al*.,[7] who worked on the effect of peanut on the kidney in male Wistar rat and reported a reduction in weight of the peanut-treated group. It has been suggested that, peanut intake provides high vitamin A, vitamin E, folate, calcium, magnesium, zinc, iron, and dietary fiber, and decrease the level of saturated fat, cholesterol, triglyceride and thus causes reduction of body weight [21].

At the end of phase one, only the mean Red blood cells in the different groups were significant between the mean control value and the mean cooked groundnut value, the mean fresh groundnut value as well as the mean fried groundnut value. For the non-significant hematological parameters, the mean PCV value for the fresh groundnut group was the highest with cooked groundnut group being the least. For the mean Hb value, control group was the highest while cooked groundnut group was the least. For the mean WBC value, the fried groundnut group was the highest while the control was the least. For the mean platelet value, the fresh groundnut group was the highest while the least was the control group. For the mean RBC value, control group was the highest with the cooked groundnut group being the least. For the mean neutrophil %, the cooked groundnut group was the highest while the fresh groundnut group was the least. For the mean monocyte %, fried groundnut group was the highest while control group was the least. For the mean eosinophil %, fried groundnut group was the highest while the control group was the least.

At the end of phase two, the recuperation phase, PCV, Hb, WBC and RBC values were statistically significant across groups. For PCV %; fresh groundnut group was the highest, followed by fried, control and cooked groundnut group. For the Hb value; fresh groundnut group was the highest, followed by fried groundnut group, control group, and cooked groundnut group. For PCV and Hb values, a statistical significance was observed between the control and fresh groundnut groups, cooked and fresh groundnut groups, cooked and fried groundnut groups as well as fried and fresh groundnut groups. For the mean WBC value, control group was the highest, followed by fresh groundnut group, cooked groundnut group and fried groundnut group. A statistical significance was observed between the control and cooked groundnut groups, control and fresh groundnut groups as well as control and fried groundnut groups. For RBC mean value, fresh groundnut group was the highest, followed by fried groundnut group, control group and cooked groundnut group. There was statistical significance between the control and fresh groundnut groups and the cooked and fresh groundnut groups. For the statistically non-significant hematological parameters, the mean platelet value for the fried groundnut group was the highest while control group was the least. For the mean neutrophil %, the control group was the highest while the least was fresh groundnut group. For the mean lymphocyte %, fresh groundnut group was the highest while the cooked groundnut group was the least. For the mean monocyte %, the fresh groundnut group was the highest while the control group was the least. For the mean eosinophil %, the control group was the highest while the fried groundnut group was the least.

At the end of phase one, a statistical significance was observed in urea level only with the fresh groundnut group displaying the highest mean, followed by the cooked groundnut group, fried groundnut group and the control group. A significant difference was observed in the mean urea serum level between the control and fresh groundnut groups. This was contrary to studies by other researchers who observed peanut to significantly reduce glycerol-induced elevation of serum urea and creatinine levels in rats thus indicating protective effect of this crop against renal injury [7] Meanwhile, the creatinine level revealed statistical significance between the control and the cooked groundnut groups. The cooked groundnut group displayed the highest mean, followed by the fried, fresh and control groups.

At the end of phase two, which is the recuperation period of the study, a statistical significant difference was observed in the serum urea and creatinine such that significant serum urea level was observed between the control and the fried groundnut groups as well as the fried and fresh groundnut groups; while for the creatinine blood level, a significant difference was observed between the cooked and fried groundnut groups only.

Comparing phase one and phase two of this study, there was a reduction in the values of the renal markers after the recuperation phase following a withdrawal of groundnut from the meal of the animals thus insinuating the tendency of groundnut consumption to increase the serum urea and creatinine blood level.

Similarly, changes in the tested mean hematological parameters were observed at the end of phase one and two. For both the cooked and fried groundnut groups, seven out of the nine mean hematological parameters (PCV, Hb, WBC, RBC, Lymphocyte and monocyte) that were higher at the end of phase one became lower at the end of phase two (the recuperation phase) thus insinuating that groundnut consumption contributed to their increase as confirmed by their reduction at the end of the recuperation phase following the withdrawal of cooked and fried groundnut from the meal. In addition, the mean platelet and eosinophil values that were higher in the cooked and fried groundnut groups respectively became the reverse at the end of phase two. Also for the cooked groundnut group, neutrophil and eosinophil that were lower at the end of phase one became higher at the end of phase two, while platelet and neutrophil that were lower in phase one became higher at the end of the recuperation phase.

For the fresh groundnut administered group, seven out of the nine mean hematological parameters, almost same with the cooked and fried groundnut groups were lower rather at the end of phase one (PCV, Hb, WBC, RBC, Neutrophil, monocyte eosinophil) but became higher at the end of phase two. However, only the mean platelets and lymphocyte values in the fresh groundnut fed group were higher at the end of phase one that became lower at the end of phase two.

Surprisingly, even the control group followed same trend in the tested hematological parameters which were fed throughout with standard rat feed in course of the study thus making such changes unclear. For the control group, five of the parameters which were higher at the end of phase one (PCV, Hb, Platelet, RBC, Lymphocyte) still became lower at the end of phase two; while the remaining four (WBC, neutrophil, monocyte, eosinophil) that were lower at the end of phase one became higher at the end of phase two.

Conclusion

This study has therefore shown the mixture of fifty percent groundnut and fifty percent standard feed consumption to influence some hematological parameters and urea and creatinine renal markers with a non-significant weight reduction in the groundnut treated groups. This study has also revealed the different forms of groundnut to vary significantly in phytochemistry and proximate analysis.

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Authors Contribution: We write to state that all authors have contributed significantly and that all authors are in agreement with the contents of the manuscript. “Author A”(Edibamode, Ezon-Ebidor I) designed the study and protocol, wrote the first draft of the manuscript; “Authors B ” (Iboro Efiong Edet) reviewed the design protocol and examined the intellectual content of the manuscript. “Author C” (Harrison Eruoto) did the hematological and biochemical analysis. “Author D” (Onoja Patience) did the bench work. All authors read and approved the final manuscript.

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